oblanceolate, very variable, slightly acute to obtuse, less hirsute on the upper surface; stipules ovate, acuminate, scarious-margined, inclined to be scarious with green veins; flowers like *lotiflorus*, very small, yellowish-white to pale lilac, one to three in a raceme almost sessile in the axils of leaves, peduncle lengthening to half an inch in fruit; *not* like *lotiflorus* in equalling the leaves; calyx with lanceolate, acuminate teeth, persistent; legume right-angled from the peduncle, half-ovate or slightly crescent-shaped, acuminate 1 inch long, 4 lines deep, sessile in the calyx, thick chartaceous, one-celled, sometimes cross-wrinkled; seeds in two rows, short-kidney-shaped, numerous.

Specimens have been deposited in the herbaria of the Botanical Survey of Nebraska, University of Minnesota, and Columbia College.

—J. M. Bates.

Long Pine, Neb., May 20, 1895.

VEGETABLE PHYSIOLOGY.[1]

The Action of light on Bacteria.—Under the above title Dr. H. Marshall Ward contributes an interesting article to the *Philosophical Transactions* of the Royal Society of London, Vol. 185 (1894), pp. 961–986. While his experiments have not been confined to the anthrax bacillus, most of those here detailed were made with this organism. The spores were sown in melted agar which was then poured into Petri dishes in the usual way. Portions of these agar films were then exposed to direct sunlight and to the arc light. On the shaded parts of the agar the colonies derived from these spores grew until they completely covered it, while they wholly failed to develop at first, but finally did so in small numbers on the parts exposed to direct sunlight for several hours. After exposure the cultures were placed in an incubator at 20–22° C., only being taken out to examine and photograph. By 3–4 hours exposure to direct bright sunlight and subsequent incubation for a few days, figures and stenciled letters were brought out very distinctly on the surface of the inoculated plates. That this effect is due to insolation has been shown by various writers and is now generally accepted, and that the effect is due to the direct

[1]This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

action of the light on the organisms and not to any indirect action on the culture medium, has been brought out pretty clearly by Prof. Ward's labors. That the agar remains unchanged and is still suited to the needs of the organism is shown by the fact that some colonies do always finally appear on the insolated spots. Their appearance is explained by supposing that some spores were covered by others and thus partially protected from the action of the light, which might well be the case, especially when thick sowings were made. The next step was to determine, if possible, whether one part of the spectrum was more effective than another, the conclusions of previous experimenters being very contradictory. First, a fresh culture was covered by a card board in which five circular holes were cut. One of these holes was left uncovered, one was covered by ordinary window glass, one by a dark blue glass, one by a light blue glass, and finally, one by a peculiar brownish-purple glass which absorbed most of the blue and violet rays of the spectrum. This plate was then exposed to sunlight for some hours and afterwards put into the incubator. In 18 hours there were four distinct white spots on the agar corresponding to four of the five holes in the card board, and later on that spot corresponding to the uncovered hole became the most distinct. There was also on the agar at first a fainter spot corresponding to the hole covered by the brownish-purple glass, but this spot became more and more indistinct and disappeared after the fourth day, enough colonies having developed finally to wholly efface it, thus showing that the light strained through this glass simply retarded the development of the spores. The inference was, therefore, quite strong, that the blue-violet rays largely screened out by this glass must be the effective ones. Two-chambered, ebonite cells with side walls of glass were then constructed. Into one of the cells filtered distilled water was put as a standard for comparison and into the other cell was put solutions of various substances such as aesculin, sulphate of copper, bichromate of potash, quinine, fuchsin, etc., which cut out certain rays of the spectrum. Infected films of agar were then exposed to the action of sunlight passed through water and these solutions. The light which passed through the layer of water cleared a spot on the plate every time. The result of passing the light through a solution of aesculin, which cuts out most of the blue and violet rays, was similar to that obtained by the use of the brownish-purple glass, i. e. it did not kill the spores but only retarded their germination, the insolated places being nearly obliterated in 111 hours and entirely so a little later. When sunlight was passed through a solution of potassium bichromate the result was still more striking, not

a trace of any germicidal influence being visible. From the foregoing it is apparent that the red, orange, yellow, and true green rays of the spectrum have no bactericidal action. Finally, portions of infected plates were submitted to the direct action of portions of the solar spectrum, passed through a grating as narrow as practicable (1 mm.) and through quartz plates instead of glass. These exposures confirmed the preceding and show that the infra-red, red, orange, and yellow rays of the spectrum are absolutely without effect, the spores exposed to these rays germinating as readily as those on the non-exposed parts of the film. So far as could be determined by the methods used, the bactericidal influence begins where the green shades into the blue, reaches its greatest intensity in the blue-violet in the vicinity of Fraunhofer's line G, and fades out in about the middle of the violet, the more refrangible half of the violet and the ultra violet showing no influence. Subsequently, in conjunction with Prof. Oliver Lodge of Liverpool, many experiments were tried with a powerful arc light. Even 8–12 hour exposures produced only a transient bactericidal effect when its rays had to traverse the glass covers of the Petri dishes, and in course of the experiments it was discovered that even the thinnest plate of glass is so obstinate a barrier to the bactericidal rays that it was not possible to use it and quartz had to be substituted. When this was done, 8–12 hour exposures served to kill the spores of Bacillus anthracis, and even 6 hours exposure killed great numbers of them. Exposures of infected films to the spectrum of the arc light gave results in the main confirmatory of those previously obtained. Here again the infra-red, red, orange, yellow, and green rays were without perceptible effect, but the germicidal influence did not begin in the blue-green but just beyond it in the blue, and its influence was visible into the ultra violet, the maximum effect being reached just beyond the violet. With both sun and arc light there is for a day or two after the colonies begin to appear a curious blurring of the margins of the insolated spots which gradually disappears as the colonies develop and which is attributed to halation. The germicidal effect of the arc light is so powerful, when not destroyed by glass screens, that Prof. Ward thinks it might be turned to practical account in the disinfection of hospitals, cattle sheds and similar places. In these experiments the distance of the light was two feet. The author is inclined to think that not only the lower forms of life but also all protoplasm is sensitive to these rays of the spectrum and that the higher plants escape injurious effects by having provided themselves with natural color screens. Among other low organisms which he has found sensitive to direct sunlight are a violet

water bacillus from the Thames, B. fluorescens liquefaciens, a pink bacterium (probably B. prodigiosus), the hay bacillus, the potato bacillus, and various yeasts and other fungi.

The role of Calcium and Magnesium.—Bokorny seems to have proved (*Bot. Centrb.*, 62:1) that Ca and Mg are essential to the formation of the necleus and chlorophyll bodies. His experiments were with Spirogyra, Zygnema, and Mesocarpus in Aluminum beakers in distilled water to which nutrient salts were added: (1) Ca withheld; (2) Mg withheld; (3) Ca and Mg withheld; (4) Complete. The algæ were under observation 6 weeks. In 1 there was a gradual decided shrinkage of the chlorophyll bands although starch continued to form. In 2 the nucleus and pyrenoids also shrank, the former to $\frac{1}{4}$ natural size or to complete disappearance. In 3 the nucleus shrank decidedly and the pyrenoids seemed to become smaller. In 4 the cell-organs remained normal and the plants continued bright green.—ERWIN F. SMITH.

ZOOLOGY.

The Faunal Regions of Australia.—At the Adelaide meeting of the Australian Association for the Advancement of Science, Mr. Hedley gave a brief summary of the views held by leading naturalists in regard to the Faunal Regions of Australia, and also presented his own. The substance of his remarks were as follows:

The discrimination of the various provinces into which the Australian fauna and flora group themselves has been frequently attempted. To the earlier naturalists, from a study of scanty material and with little or no personal knowledge of the continent, four divisions of east and west, temperate and tropical, seemed natural and sufficient. Horker's "Essay on the Australian Flora" paved the way for a better understanding of the relations which various localities bore to each other. Owing to fundamental errors of his interpretation of Australian Geology, Wallace's treatment of the subject in "Island Life" is of but slight value. To the writer, the most successful arrangement of the various biological regions yet proposed is that sketched by Prof. Tate, in his address to the first meeting of this Association. The author accepts two main biological divisions—the *Autochthonian*, developed in west